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ABSTRACT

Reported is a study of the attitudes of elementary school students toward science as a school subject. This study was undertaken in order to determine the effects of an in-service teacher training program in the use of the Science Curriculum Improvement Study (SCIS) program. Children in grades two through six (N-1941) from four suburban (85 percent white, lower middle class) school districts were tested. The study was carried out in three steps, with different children being used in each step. In Step One, pupils in grades two and three were tested; in Step Two, pupils in grades four, five and six. In both steps, children taught by teachers participating in the in-service program were compared with children who had not studied SCIS materials. In Step Three, pupils in grades four, five, and six from a wider variety of teacher training and science program backgrounds were compared. Children were asked to complete an attitude test or questionnaire appropriate to their grade and reading levels. Significant differences were searched for by the use of the t test. Additional data analyses involved Scheffe multiple comparisons. Attitudes of students working with teachers participating in the in-service program were more favorable to science than attitudes of children with non-participating teachers. This was true even in classrooms where some non-participating teachers were using SCIS materials. (Author/PEB)

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A STUDY OF THE EFFECTS OF A CCSSP TEACHER TRAINING PROGRAM ON THE ATTITUDES OF CHILDREN TOWARD SCIENCE

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Synopsis

In order to determine the effects of an inservice teacher training program in one of the NSF funded programs (SCIS), a study was made of the attitudes of Elementary School students towards science as a school subject.

A total of 1941 subjects from grade two to grade six were tested. It was found that the attitudes of students working with participating teachers was more favorable toward science than the attitudes of students with non-participating teachers. This was true even though some non-participating teachers were teaching SCIS.

Introduction

The affective outcomes of education have the highest priority for parents, teachers and school administrators.(1) Curriculum development has recognized this to some extent. We are aiming generally at scientific literacy, but we also want pupils to like science. Falling enrollments in elective science courses at the high School and college levels is frequently interpreted as a failure to achieve our affective goals in science education. Research on the affective outcomes of our efforts is scanty. This is especially true at the elementary school level. The research reported here is an effort to use affective outcomes as an indicator of the success of a teacher training

program. The affective outcome used, "Attitude toward science as a school subject", would be classified by Krathwohl, Bloom and Masia as "Satisfaction in Response".(2)

Evaluating an inservice teacher training program in terms of affective outcomes is a tricky business. Are the outcomes observed due to the science program itself or is the training procedure responsible? Step One and Step Two did not attempt to deal with this question. Step Three did probe this area.

Method

Subjects:

The subjects were 1941 students from 90 classrooms in four suburban school districts. The population was about 85% white, lower middle class. The range of grades was from second grade through sixth grade. Different children were used in each step of the research.

Procedure:

The study was carried out in three steps. In the Step One, children in the second and third grade were tested. In the Step Two, children in 4th, 5th and 6th grades were tested. In both of these steps, children who had never had the Science Curriculum Improvement Study program were compared with children taught by CCSSP participants. These children had used the SCIS program for about seven months at the time of testing.

In the final step, Step Three, children at the 4th, 5th and 6th grade levels with a wider variety of teacher (training) and science program backgrounds were compared.

In the first two steps of the study, the subjects of the study were students in classes which were taught either:

(a) by a teacher who was a participant in an NSF sponsored, inservice training program in the Science Curriculum Improvement Study Program, or

(b) taught a standard textbook science program by a nonparticipating teacher.

Since the pretest - posttest format was objectionable to teachers and administrators, an effort was made to match classes. For each class taught by a "participant" there was a class in the sample taught by a "nonparticipant" in the same school and at the same grade level. In some schools such a match was not possible. This led to an unequal number of students in various categories.

The Attitude Test used with second and third graders was one which required students to place a number (1 to 5) next to the subject which they like best (1) second best (2) etc. "Math", "Science", "Reading", "Social Studies", and "Language Arts" were placed in two rows with "Science" in the next to last position in the bottom row. The teacher administered the test to the entire class with oral instructions and no connection was made to science in the administration of the instrument.

A more complex format was used with 4th, 5th and 6th graders. A simple questionnaire (attached) asked children to recall their earlier impression of science in school with five choices ranging from "horrible" to "great." The same question was asked to determine their impression of science this year. The second part of the questionnaire was open-ended: "Tell what you think." Four brief questions asked children to tell what they liked most and least about science previously and at present.

Initial pilot testing indicated that this instrument was only marginally suitable for third graders, but it posed no reading or response problems for children in higher grades.

A breakdown of the population in Step One of the study is as follows:

	Experience	
	SCIS	Non-SCIS
Grade 2nd	102 students	283 students
Grade 3rd	95 students	159 students

Table 1 The Distribution of Subjects in Step One

In Step Two:

	Experience	
	SCIS	Non-SCIS
Grade 4th	46 students	43 students
Grade 5th	86 students	50 students
Grade 6th	101 students	55 students

Table 2 The Distribution of Subjects in Step Two

In Step 3 there was a more varied population used in order to make additional comparisons possible. There were two groups of students taught by inservice participants: Group A had the SCIS program previously with an untrained teacher; Group B had never had SCIS previously. Two other groups were taught by nonparticipating, relatively untrained (in SCIS) teachers: Group C were using the SCIS program; Group D were using a more traditional textbook science program. The distribution of this population is shown in Table 3.

TEACHER PARTICIPANTS		TEACHER NON-PARTICIPANTS	
Group A	Group B	Group C	Group D
SCIS previously	No SCIS previously	SCIS now	No SCIS now
9 classes 234 students	13 classes 287 students	11 classes 273 students	6 classes 127 students

Table 3 Distribution of Students in Step Three

Results

Step One

The mean for the SCIS group was 2.492 (a score of 1 for favorite subject) with a standard deviation of 1.37. The mean for the Non-SCIS group was 3.136 with a standard deviation of 1.45. A t test showed that this difference is significant ($p < .01$).

Discussion

Although the attitudes of young children are not very stable, the sample was large enough to give some confidence in the results[3]. There was no way at this point to know whether we would have observed this difference without any teacher training. The SCIS program itself may have been responsible for the observed difference. We did establish the fact that all of the non-SCIS classrooms were doing some science.

Results

Step Two

	SCIS		NON-SCIS	
	Previous Science	Science This Year	Previous Science	Science This Year
horrible	20%	3%	13%	12%
not so good	26%	8%	21%	20%
OK	27%	22%	35%	34%
very good	17%	25%	17%	17%
GREAT	10%	42%	14%	17%

Table 4 A comparison of attitudes towards science previously (recall) and science as taught this year for SCIS taught children and NON-SCIS children.

	SCIS	NON-SCIS
dislike reading textbook	28%	16%
like doing experiments	35%	24%

Table 5 A comparison of SCIS and NON-SCIS students on their major likes and dislikes in science.

	SCIS	NON-SCIS
Mean	2.515	3.062
Standard Deviation	1.04	1.77

Key: Horrible = 5, Great = 1

Table 6 A Comparison of Means and Standard Deviation for "Science this Year."

A *t* test shows that this difference is significant. ($p < .01$)

Discussion

Table 4 shows some interesting findings. Among the children who were taught by teachers in the CCSS Program, there was a wide-spread feeling that previous science experiences in school were less than "OK" (46%). The children in the more traditional programs viewed their earlier experiences less harshly since only 34% judged them as less than "OK". (This might be expected since the SCIS program has given the children a new standard by which to view their earlier experiences.)

It is especially striking (Table 4) that although 20% of the SCIS students view previous science as horrible, only 3% see this year's science as horrible. On the other hand, 42% of the SCIS students see this year's science as "GREAT". This is in sharp contrast to the results for those students who have not had the SCIS program. There is very little change in attitude towards science among "NON-SCIS"

students. The distribution of attitudes among these students is less skewed towards GREAT or horrible with the peak of the distribution at "OK" for "previous" and "present" science.

Taking a closer look at the changes of attitude as indicated in Table 4 we find among those students who indicate an improvement of attitude, that the extent of change on the part of the SCIS students is much greater than among the NON-SCIS students. Using a scale of 1 to 5 for the values from "horrible" to "GREAT" the average change for SCIS children who saw this year's science as better than previous science was 2.2. Those children in NON-SCIS classes who saw an improvement averaged only 1.6. This was due to the fact that 26 children in SCIS classes saw the difference from previous science to this year as from "Horrible" to"GREAT" while only 6 children in NON-SCIS classes saw this degree of change. Similarly 24 "SCIS" children saw a change from "not so good" to "GREAT" while only 2 "NON-SCIS" children felt this change.

These results might be dismissed as a "Hawthorne Effect" if it were not for the answers to the "open-ended" questions. The children in both the SCIS and NON-SCIS classes were very clear concerning what they liked and what they disliked about science. They liked "experiments" and they disliked "reading out of a textbook". It is interesting to note that the children in SCIS classes had a higher percentage of replies in both of these areas. (see Table 5)

It is apparent from these replies that the SCIS children who like science must be doing less reading and more experiments. The NON-SCIS children maintain their feelings toward science unchanged as Table 4 shows, indicating that they still read too much out of textbooks and they don't do enough experiments.

It is also interesting to note that a large percentage of NON-SCIS pupils (53%) mentioned a specific science content area when giving reasons for past and present liking or disliking of science. Relatively few (36%) of the SCIS pupils mentioned either a content area or specific SCIS topics. An example of this contrast is the "NON-SCIS" pupil who says: "The thing I like most about science now is the part on prehistoric life", "The thing I like least about science now is the part on chemicals and atoms", and the SCIS pupil who says: "The thing I like most about science now is you can find out about things for yourself." This difference is significant because, unlike the traditional programs which frequently have a heavy stress on facts, definition of terms and a "rhetoric of conclusions", the SCIS program is more interested in the process of inquiry and subordinates conclusions to the systematic gathering of evidence. It would appear from this contrast on the open-ended answers that this rather subtle differnce in programs is making a difference in the children's concept of science.

Again, the results of Step Two do not indicate whether the differences observed can be attributed to the SCIS program

or to the teacher training program. A sample of children using SCIS with non-participating teachers was not available at this point.

Results

Step Three

	Teacher Participants				Teacher Non-Participants			
	Group A SCIS previously		Group B No SCIS previously		Group C SCIS now		Group D No SCIS now	
	Previous Science %	Science Now %	Previous Science %	Science Now %	Previous Science %	Science Now %	Previous Science %	Science Now %
horrible	16.5	4.2	21.1	0.9	8.5	6.5	10.1	7.1
not so good	15.5	6.4	29.8	1.7	25.0	9.0	16.3	15.0
OK	30.1	20.9	31.5	11.2	37.2	17.1	50.8	21.3
very good	12.3	19.7	9.1	22.4	13.4	31.6	11.3	32.6
great	24.5	47.7	8.0	63.3	16.2	36.8	11.8	24.8

Table 7 A comparison of attitudes towards previous science (recall) and science as experienced this year for each group of students.

Another comparison between the four groups was made by determining the extent of change of attitude expressed by each child. For instance, a change from "horrible" previously to "great" now would be +4. The opposite change would be -4. The mean change for each group was determined. These results are shown in Table 3.

Group A	+ .93
Group B	+1.9
Group C	+ .73
Group D	+ .55

Table 8 The mean change in attitude between previous science and science now for each group.

In step 1 of the study a comparison was made between the groups sampled on a "favorite subject" basis. A score of 1 represented a high affective value placed on science, a score of 5 represented a low value. In step 2 (Table 6) this comparison was repeated using present attitude towards science "GREAT" being scored 1 and "Horrible" given a score of 5. This procedure was repeated in step 3 with the results shown in Table 9.

	Group A	Group B	Group C	Group D
Mean	1.99	1.55	2.16	2.48
Standard Deviation	1.33	.71	1.42	1.47

1 = Great 5 = Horrible

Table 9 The Mean and Standard Deviations of Each Group for "Science Now" Attitude Scores

A *t* test was carried out and a Scheffé multiple comparison gave the results shown in table 10.

Groups	Significance
A-B	$p < .01$
A-C	N.S.
A-D	$p < .01$
B-C	$p < .01$
B-D	$p < .01$
C-D	$p < .05$

Table 10 Scheffe Multiple Comparison of scores for each group on attitudes towards "Science Now"

Discussion

The great difference between group B, (students who have had no previous SCIS taught SCIS by a participant, and group D, students who have not had any SCIS) is expected in light of our earlier work. Group A feels that previous science was poor in comparison with their new SCIS experience. The idea that this effect might be due to the SCIS program itself rather than attributable to teacher participation in the CCSS program is dispelled by the contrast between Group B and Group C, students who are experiencing SCIS but whose teachers are not participants. Some light is shed on the effects attributable to the novelty of a new program by examination of the results for Group A. The students in Group A have had SCIS previously but are now being taught by a participant. Although they see previous science in a favorable light, they are even happier about present science.

Their present favorable attitude is not due to the novelty of the SCIS. The only difference for them is the training received by their present teacher. These two contrasts, B-A and B-C, give strong support to the idea that teacher training is very important for implementation of the new science programs. It is interesting to note that the attitudes expressed by Group C (SCIS, non-participant teacher) are closer to those of group D (no SCIS experience) than to groups A and B. Teacher training seems to make a greater difference than the science program taught.

Open-ended Questions: results and discussion

The answers to the open-ended questions closely parallel the pattern observed last year. Students working with participant teachers doing SCIS for the first time expressed strong negative feelings about learning science from a book (50% to 60%) and equally strong positive feelings about "doing experiments ourselves." As many as 30% of the students in these classes liked nothing about science as previously experienced and disliked nothing about present science. Students who have never had SCIS seldom followed this pattern of responses. The predominant mode of response for these students was to mention specific subject matter as liked and disliked previously and at present. Frequently if "learning about weather" was disliked previously, it was also disliked at present. One 6th grader expressed the implication of this by stating, "We did the same things almost every year."

In the group of students who have had SCIS previously, there was frequent mention of "not enough science" or "not often enough" as a negative comment, for science both years. One comment that was unique among SCIS students was made concerning SCIS previously (Group A) and present SCIS (non-participant teacher, Group C) was stated as "we did not do the experiments ourselves", or "we only did some experiments" or "we had to sit and listen." One of the students in Group A made this very encouraging comment, "I don't think I will ever hate science any more."

Ball's[3] dictum to use large samples in measuring the attitudes of children seems to have paid dividends in this research. The methods used to measure attitudes were rough hewn in comparison to a carefully constructed sematic differential or a multiple item Likert-type instrument. However, there is some advantage to be gained by a direct, simple approach in determining a generalized set or feeling. More complex approaches pose reading difficulties which may skew the results one way or the other.

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FL/ldp

CIRCLE THE ANSWER

I used to think that science in school was:

horrible | not so good | OK | very good | great

This year I think that science in school is:

horrible | not so good | OK | very good | great

TELL WHAT YOU THINK

The thing I used to like about science was _____

_____

The Thing I did not like about science was _____

_____

The thing I like about science now is _____

_____

The thing I do not like about science now is _____

_____